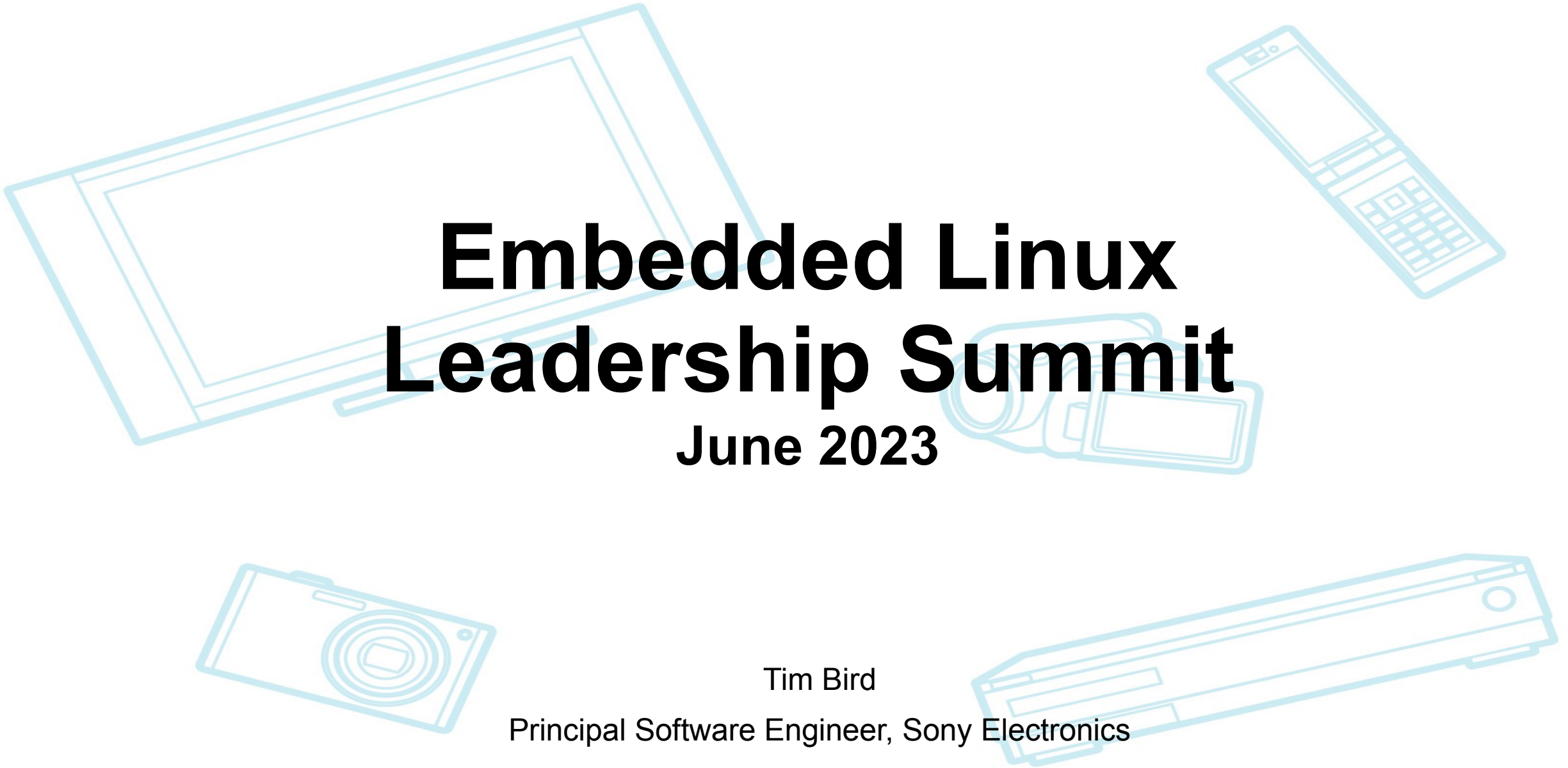


Embedded Linux Leadership Summit

June 2023

Tim Bird

Principal Software Engineer, Sony Electronics

Agenda

- Introductions
- What is each organization, project or company focused on?
- Barriers to adoption of embedded Linux in your area
- Health of Linux in your area?
- Supplying resources, leveraging efforts, avoiding duplication of effort
- Sustaining the ecosystem
- Followup

Introductions

- Drew Fustini – RISC-V, BayLibre
- Grant Likely – Linaro
- Jan Kiszka - CIP, Siemens
- Jan Lubbe - Pengutronix
- Kate Stewart - LF Dependable Embedded, RT, Zephyr, SPDX
- Kevin Hilman– KernelCI, BayLibre
- Mark Filion – Collabora
- Megan Knight - Yocto Project, Amazon
- Philipp Ahman - ELISA, BOSCH
- Richard Purdie - Yocto Project
- Steve Rostedt - Kernel, Google
- Sjoerd Simons – Collabora
- Tim Bird - CELP, LF, Sony
- Thomas Petazzoni - Kernel, Buildroot, Bootlin
- Yoshitake Kobayashi - CELP, Toshiba
- Walt Miner - AGL

Linux Foundation projects

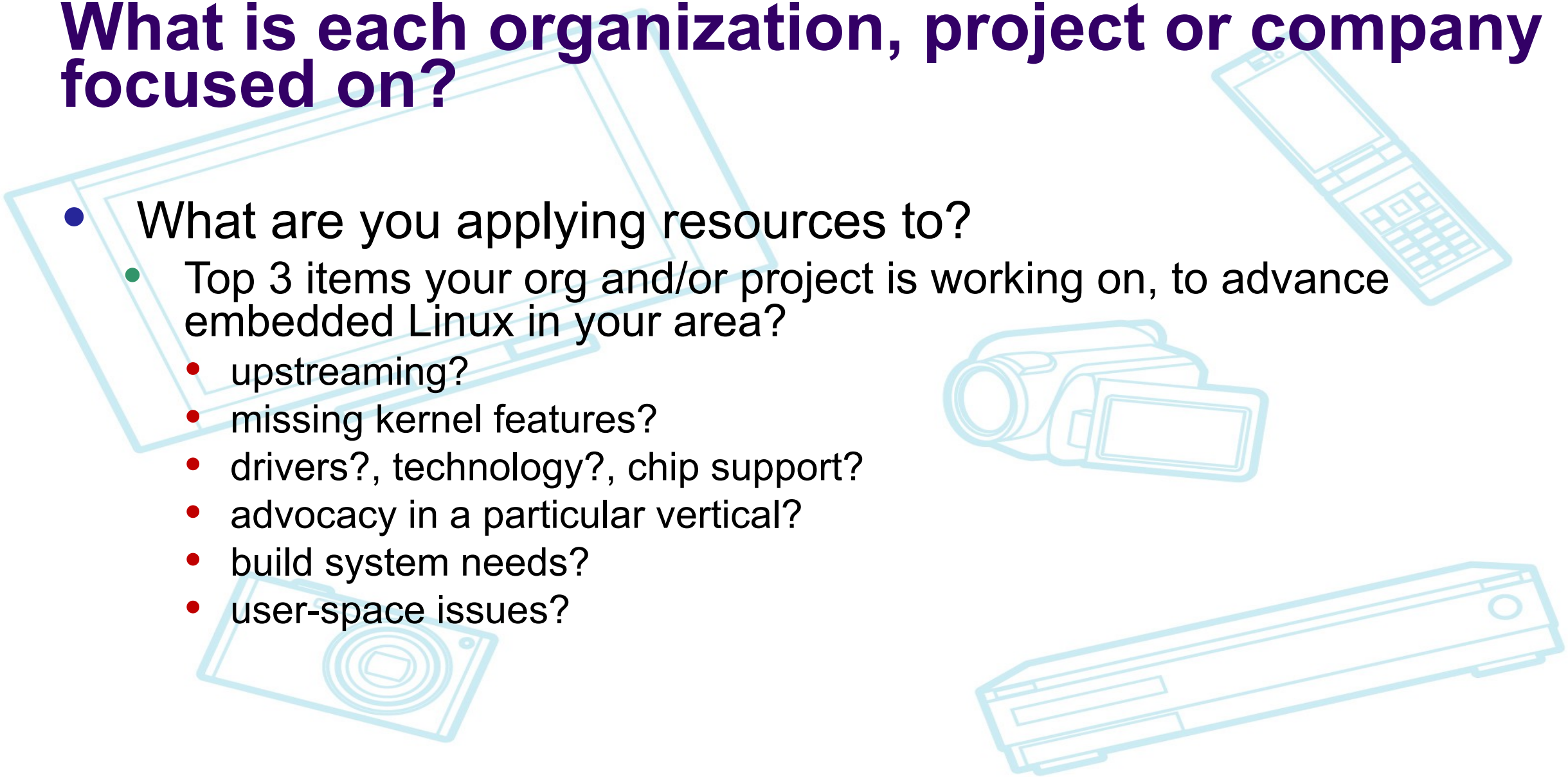
- Linux Foundation
  - Core Infrastructure Project (CIP) – handles support longevity
  - ELISA – handle issues with safety certification and standards
  - OpenChain – handles issues with supply chain
  - SPDX – handles licensing issues and SBOMs
  - Automotive Grade Linux (AGL) – handles automotive vertical
  - KernelCI – handles automated testing (for upstream)
  - Yocto Project – handles common build system for embedded
  - DroneCode – handles drone vertical
  - Core Embedded Linux Project – is shutting down

Core Embedded Linux Project

- History:
  - Started as Consumer Electronics Linux Forum in 2003
  - Migrated to Embedded Linux Workgroup in the LF in 2011
  - Became Core Embedded Linux Project in 2015
- Funded upstreamining of various technologies
  - Linux-tiny patches, squashfs, realtime work, power management features, etc.
- Started the Embedded Linux Conference
- Sponsored the eLinux wiki for many years
- Now, plan to end in July 2023 (after 20 years)

What is each organization, project or company focused on?

- What are you applying resources to?
  - Top 3 items your org and/or project is working on, to advance embedded Linux in your area?
    - upstreaming?
    - missing kernel features?
    - drivers?, technology?, chip support?
    - advocacy in a particular vertical?
    - build system needs?
    - user-space issues?



Barriers to adoption of embedded Linux in your area

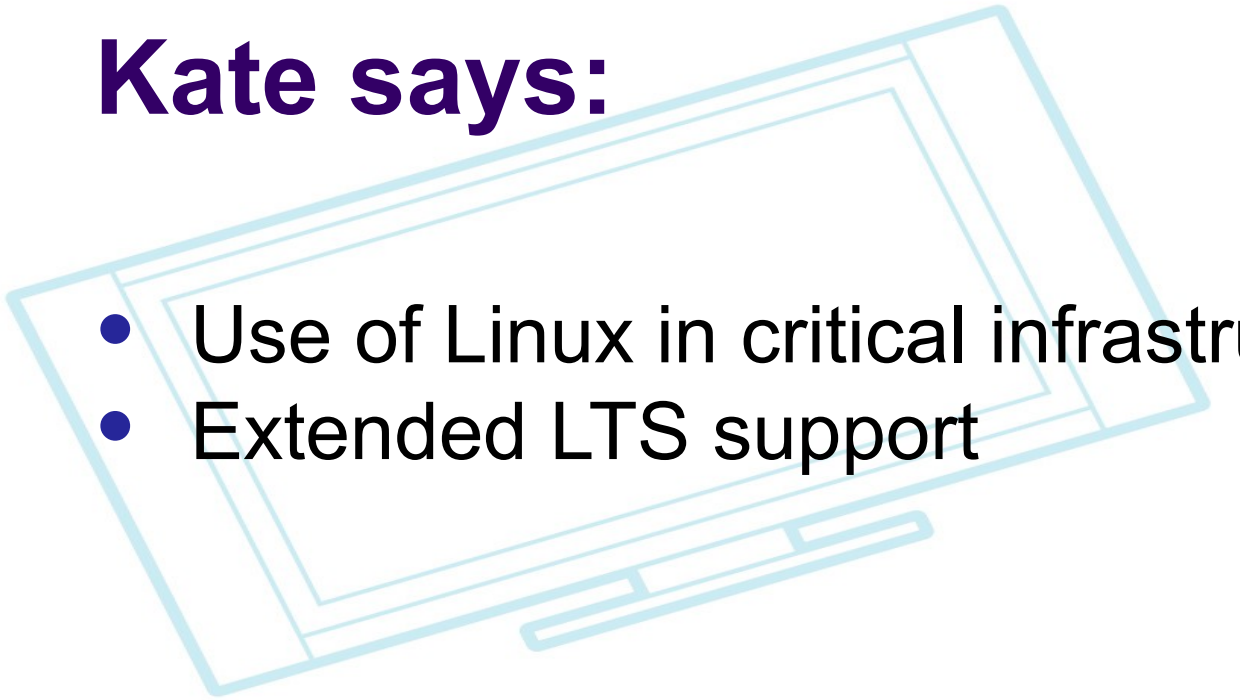
- What are your pain points?
  - Example: in space missions:
    - A big barrier is certification (Open Source process does not match standards requirements)
    - trust that Linux is stable and trustworthy (qualification, proof of correctness)
    - Trust in Linux Realtime support
      - As witnessed in space panel yesterday
    - Power management (power budget is often extremely tight)
    - Robust failover architectures
    - Integration between space community and Linux community
      - e.g. no-one from kernel community shows up at satellite or flight software conferences
      - But an RTEMS rep. does

AGL pain points

- Walt said:
  - Keeping vendor kernels up to date has long been a concern of mine and I will admit that I never thought much of LTSI as a solution. I would be happy if we could figure out a way to have Greg's LTS releases bubble up to AGL and other Yocto users using the vendor kernels.
  - The other problem we have been considering is how to use Yocto and OE to bring later kernel versions into AGL while still using the Yocto LTS.
  - The issue for AGL and our members becomes which version to chase and support since there ends up being too many combinations to support without a guarantee that anyone would actually use any of them.
  - These are solvable problems but the real need is money and people to do the work

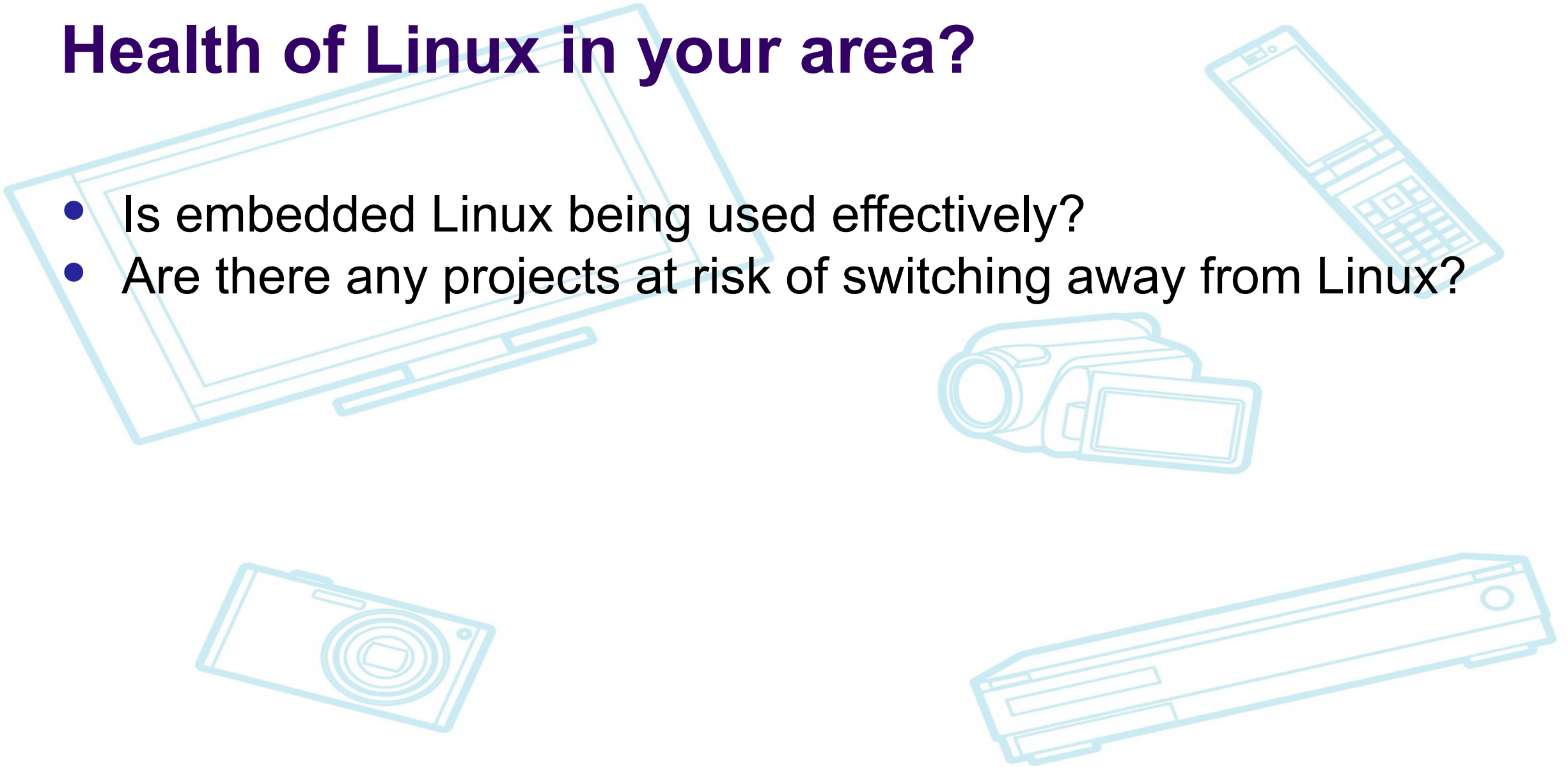
Kate says:

- Use of Linux in critical infrastructure sectors
- Extended LTS support



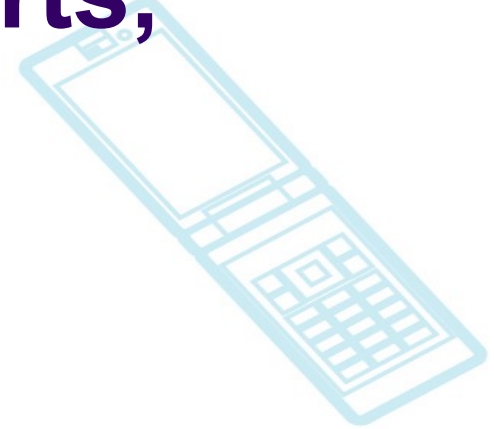
Health of Linux in your area?

- Is embedded Linux being used effectively?
- Are there any projects at risk of switching away from Linux?

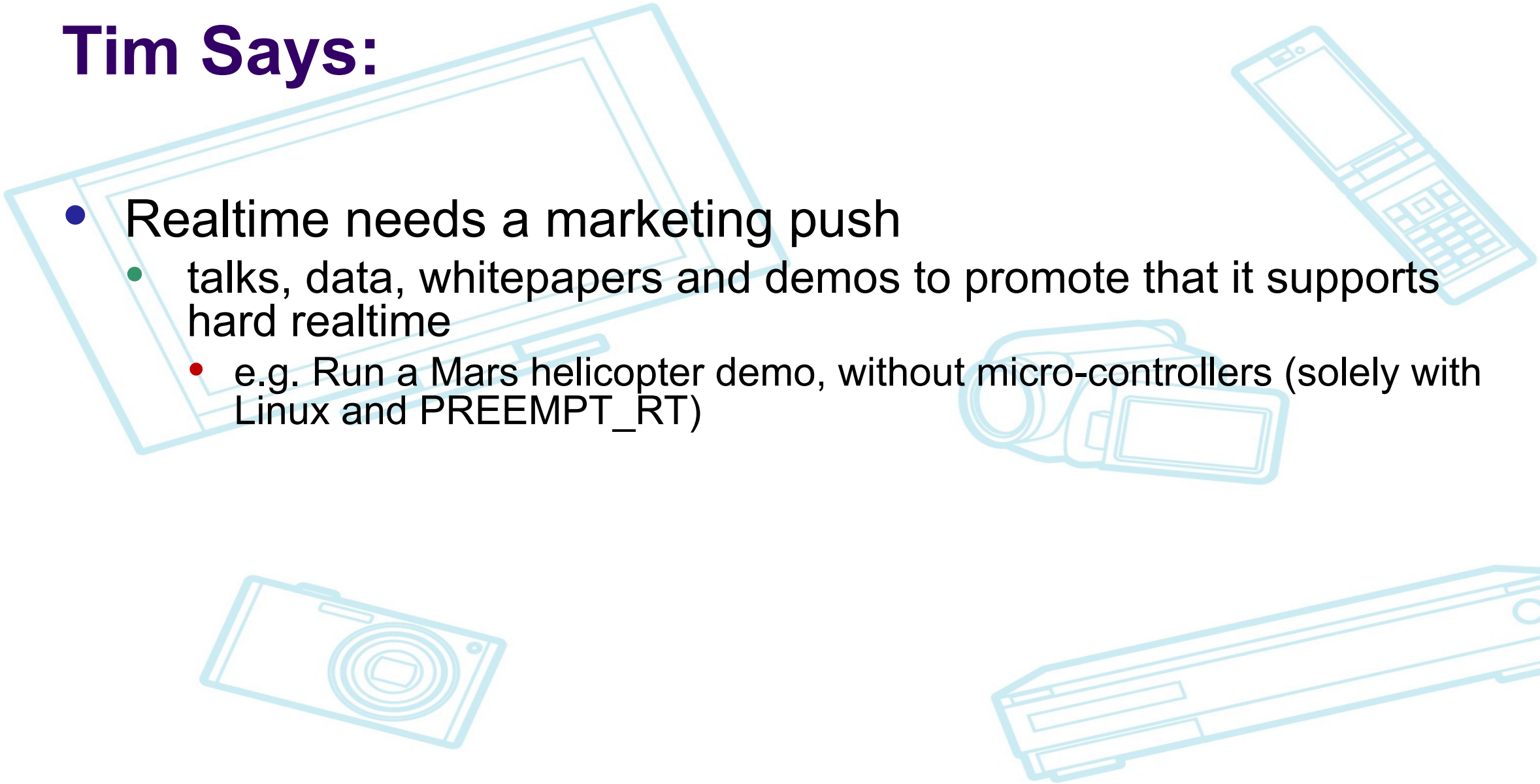


Applying resources, leveraging efforts, avoiding duplication of effort

- Projects of mutual interest
- Strategic activities
- Sustaining the ecosystem

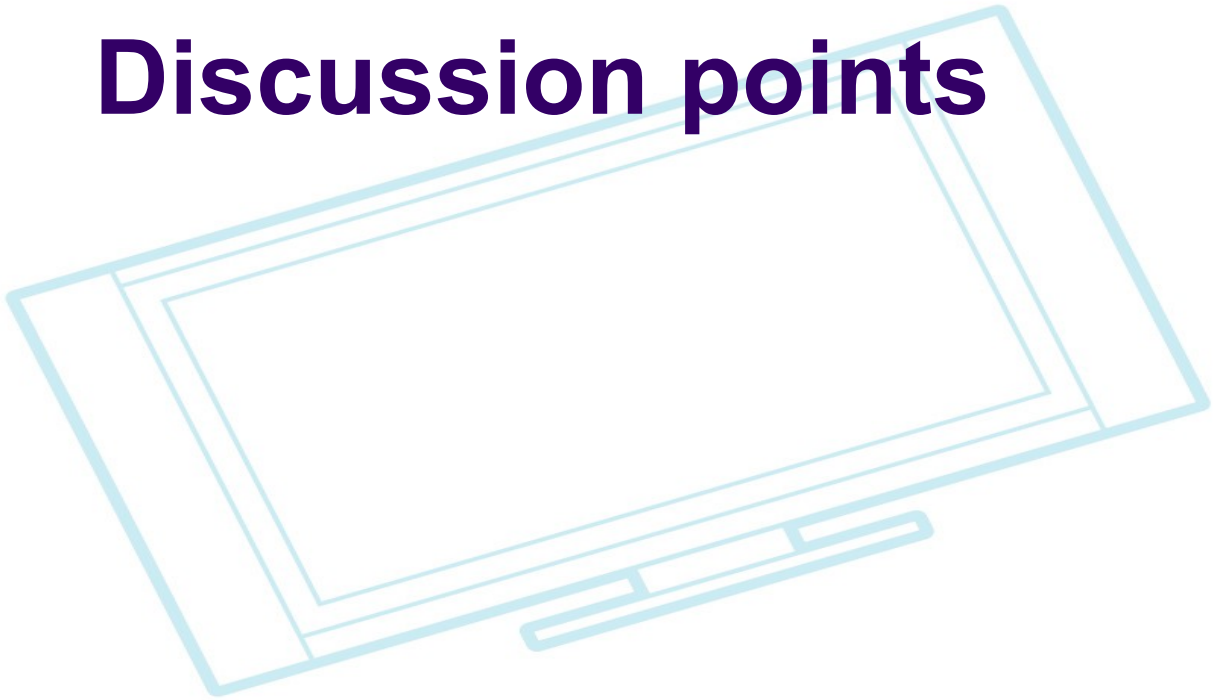



Tim Says:



- Realtime needs a marketing push
  - talks, data, whitepapers and demos to promote that it supports hard realtime
    - e.g. Run a Mars helicopter demo, without micro-controllers (solely with Linux and PREEMPT_RT)

Discussion points



Sustaining the ecosystem

- Conferences
- Communication Channels

Conferences

- Status of EOSS/ELC?
- Is current ELC/EOSS configuration, timing, size, pricing OK?
- What other events to support/promote embedded Linux ecosystem?
  - e.g. FOSDEM?, embedded recipes (regional events?), Plumbers embedded microconference?
  - Do we need any coordination?
  - Relationship to Embedded World?
    - Not conflicting on dates would be a good start.

Regional embedded Linux Events

- Kevin says:
  - How to encourage, facilitate, and fund small, regional events in the non-ELC years?
    - Now that ELC is only any continent every other year, this leaves some space for small, regional events.
    - With the reluctance for international travel for some due to either pandemic issues or climate change issues, I think figuring out how to adapt to this new world should be something we discuss.
  - e.g. Kernel Recipes

Mark says:

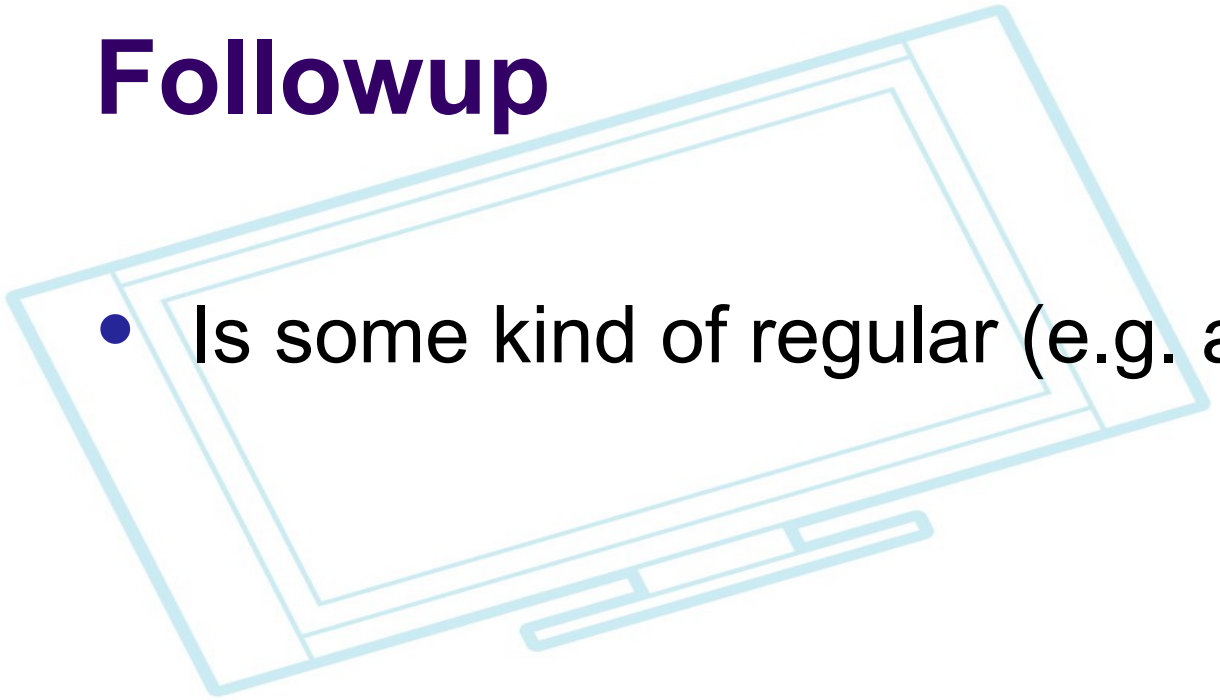
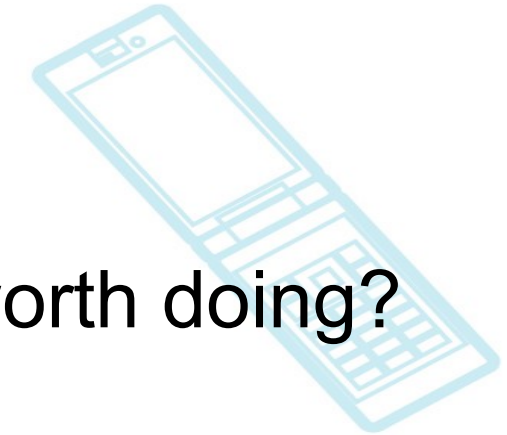
- ... I spent quite a bit of time earlier this year speaking with multiple event organizers (Kernel Recipes, Embedded Recipes, XDC, Linux Plumbers) to ensure conferences did not clash with each other this year
  - There really is no reason to have two FOSS conferences taking place at the exact same time).
  - This enabled us t have one conference per month this Fall, so no one is stepping onto each other's toes.
- ... quite a few companies now significantly limit event travel
- I also brought up the idea of creating some sort of "freedesktop week", where the main freedesktop conferences (XDC, FOSS XR & GStreamer Conference, PipeWire) would take place in the same city, in the same week.

Communication channels

- elinux wiki
  - Is it useful?
  - Who is willing to administer or owner it?
    - Does it need an administrator or owner?
- Mailing list
  - Something for leaders (similar to ksummit-discuss)?
  - Something for entire ecosystem?
    - Chat room?, Discussion board? e.g. Matrix server?

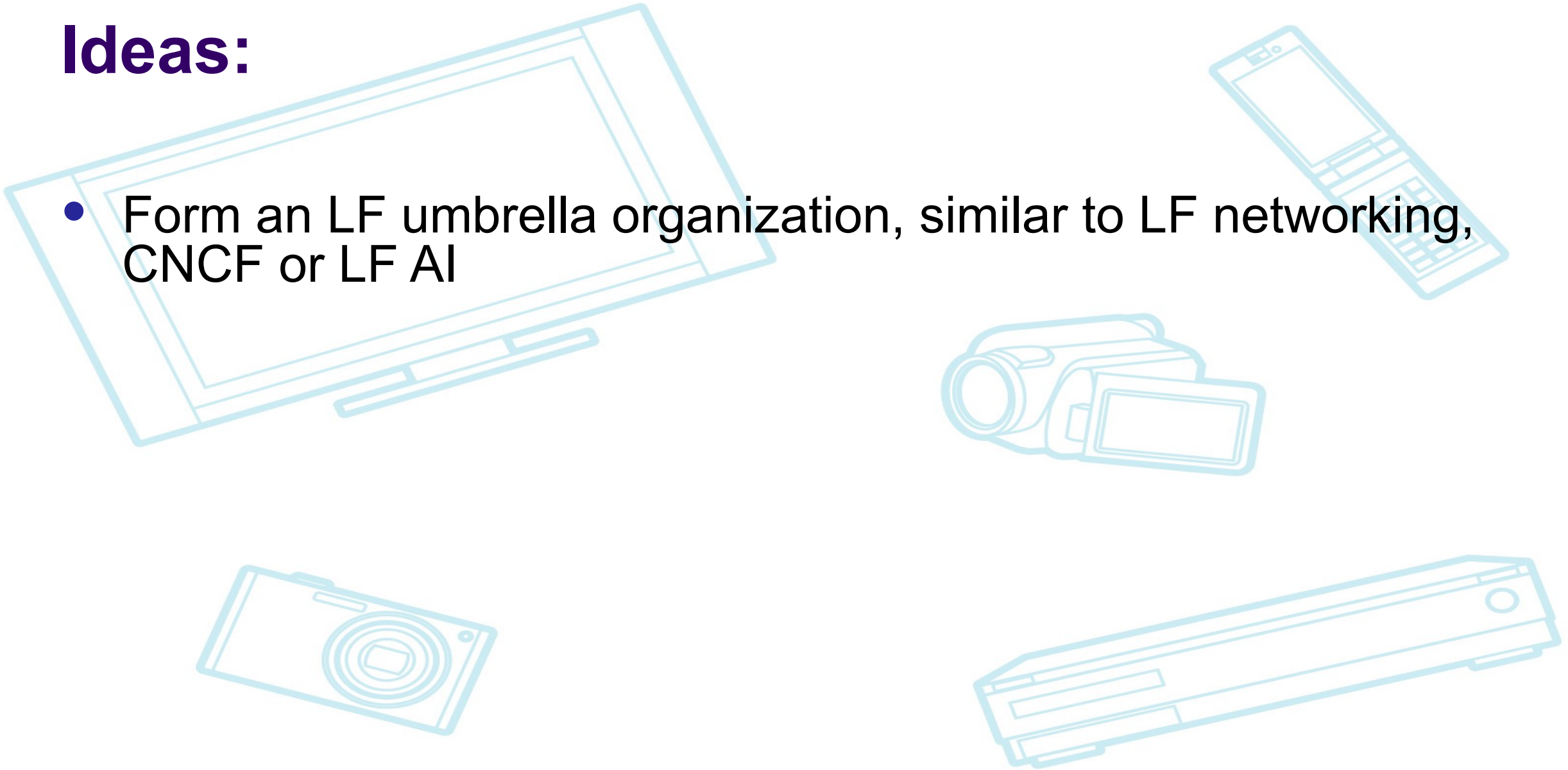
Followup

- Is some kind of regular (e.g. annual) meeting worth doing?

Ideas:

- Form an LF umbrella organization, similar to LF networking, CNCF or LF AI



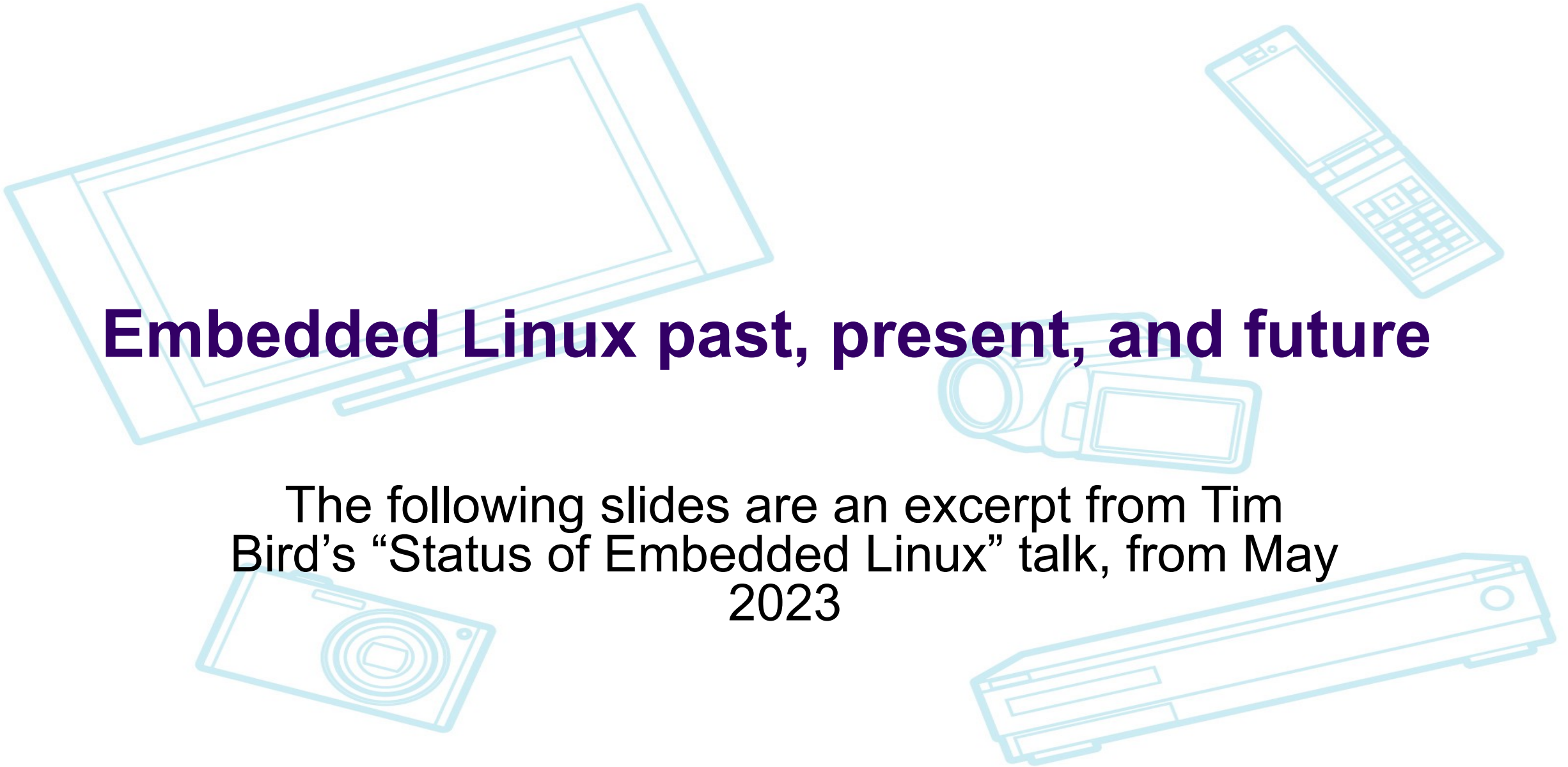
Robert Schwebel wrote:

- The idea of taking the technical strategy questions back into the hands of people actually involved with core development topics sounds really good to me.
- The time since Linux Foundation took over made the whole thing big, but let's face it: Do you remember the Cambridge or Grenoble conferences, where everyone in the room was deeply involved with Embedded Linux?
  - You could talk to whomever you wanted, and alwasy found a common ground for interesting talks, make plans etc.
- The Linux Foundation is good in organizing big conferences, but nowadays everyone you accidentially meet is some hyperledger or cloud or storage or whatever person...
  - So EOSS (with a big focus on E) Summit is a good step into the right direction.

Robert Schwebel wrote:

- On the technical + strategic side, things work with the Linux Foundation in some areas (like RT), but in others they don't.
- For example, We were quite happy to see the DENT project, but then it came to the first discussions (we do quite a lot of network things recently, and so does Bootlin) between Thomas Petazzoni, us and the DENT folks, it quickly turned out that DENT folks are on a strange big-company-driven trip into completely insane userspace blob ideas, instead of making use of all the infrastructure experience of the involved kernel folks.
- It's always easy to find a common ground with the other Embedded Linux protagonists, but discussions with the Amazon folks felt like something coming from another star.

End of meeting slides

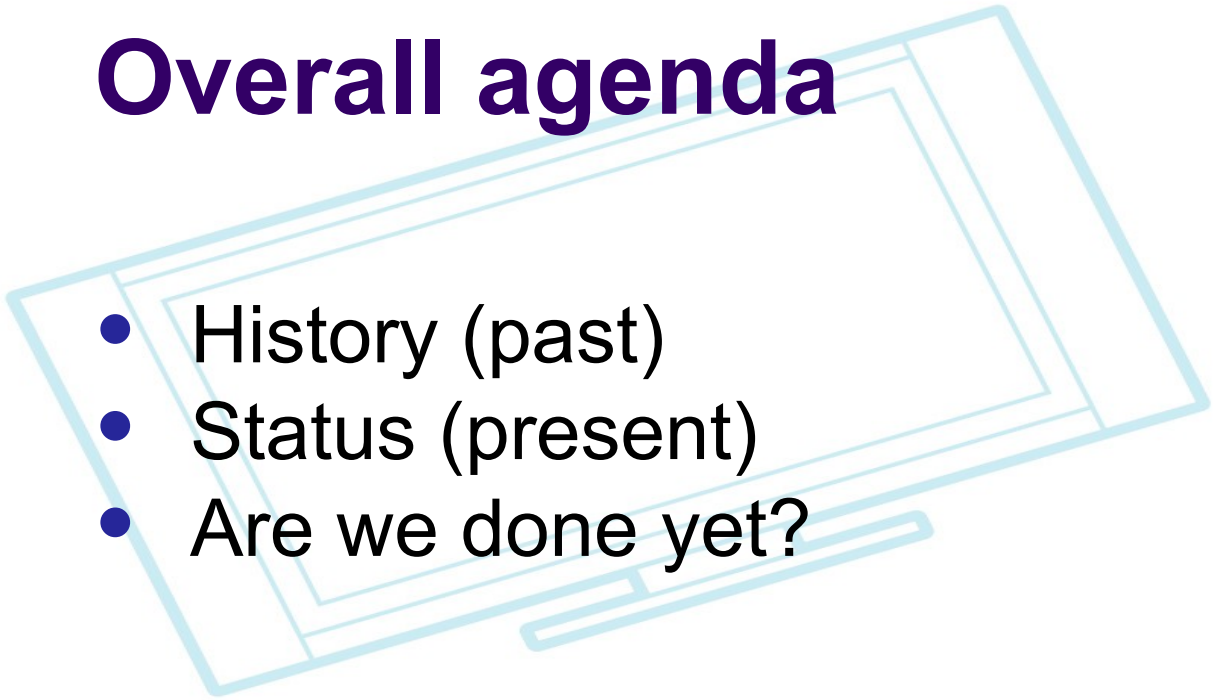


Embedded Linux past, present, and future

The following slides are an excerpt from Tim Bird's "Status of Embedded Linux" talk, from May 2023

Overall agenda

- History (past)
- Status (present)
- Are we done yet?



A long time ago...

- In 1998, I started working on embedded Linux at Lineo
- In 2003, I was hired by Sony to help start the “Consumer Electronics Linux Forum” (CELF)
  - In 2005, CELF started the Embedded Linux Technical Conference
- In 2010, CELF became part of the Linux Foundation that became the “Core Embedded Linux Project” (CELP)

In the early days...

- In the ’90s we spent lots of effort convincing companies that Linux was suitable for embedded devices
  - Competition back then was: VRTX, VxWorks, pSOS, Nucleus, µItron (ie Commercial RTOSes)
- Architecture support: Intel, ARM, MIPS
  - But, no major chip vendor wrote arch support for Linux
  - It was all community developers, or nascent embedded Linux companies
- Embedded distros: Roll your own, or MontaVista, Lineo, TimeSys

Focus areas back then

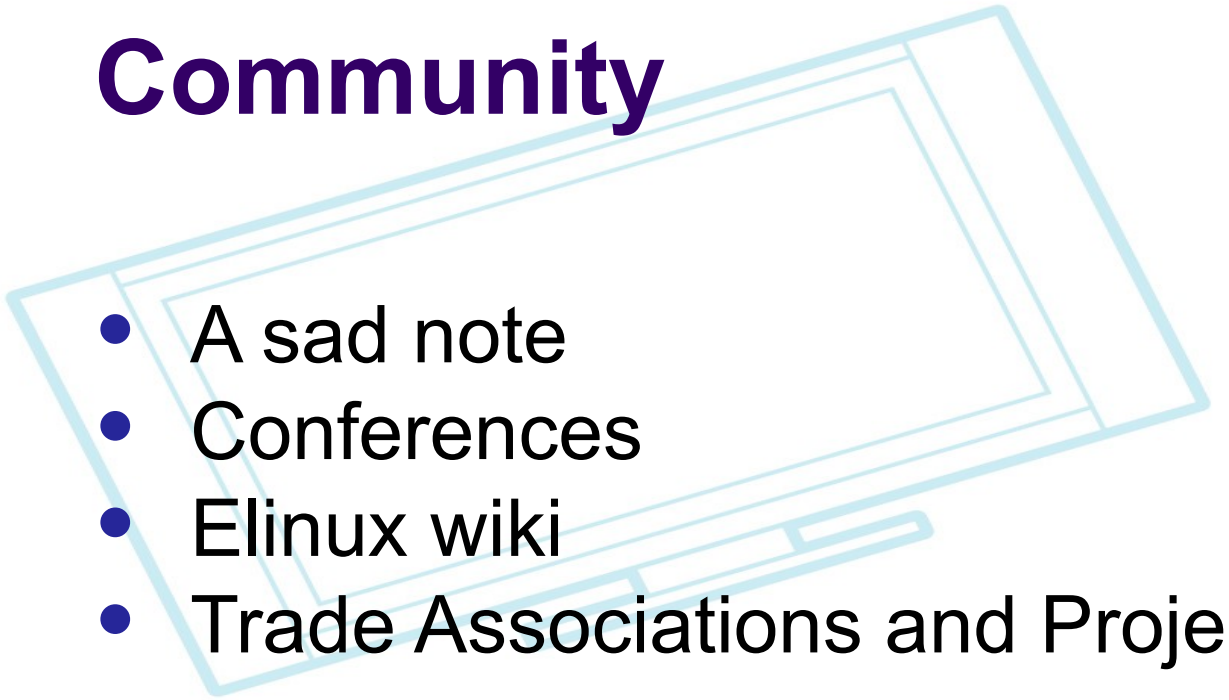
- CELF spent time analyzing and trying to address deficiencies in Linux, to make it suitable for embedded
- In 2003, CELF identified 5 key areas that needed work:
  - System size
  - Boot time
  - Power management
  - Realtime
  - Security
- CELF funded the contribution of several features in the Linux kernel in these and other areas (like filesystems)

Outline

Linux Kernel
Technology Areas
Industry News
Community
Scorecards
Conclusions

Community

- A sad note
- Conferences
- Elinux wiki
- Trade Associations and Projects



Conferences

- Embedded Linux Conference
  - Is now only once a year
    - Alternates between Europe and North America
    - So, effectively only once per region every two years
    - May decide to fill in with regional events or Plumbers
  - Sometimes in Embedded Open Source Summit, and sometimes in Open Source Summit (North America)
  - Consistently in the spring (April/May)
  - Next one = June 28-30 in Prague, Czech Republic
  - 2024 = April 15-19 in Seattle, USA

Conferences (cont.)

- Japan Jamboree
  - Not sure if there will be more after #80 – held in May, 2023
- Embedded Recipes
  - September 28-29, 2023 in Paris
- Linux Plumbers
  - Could have an embedded microconference
  - November 13-15, 2023 in Richmond, Virginia, USA
- FOSDEM
  - Has an embedded track
  - February 3,4 2024 (not confirmed) in Brussels

Elinux wiki

- Losing funding for our elinux.org administrator (Bill Traynor)
- Site is still used for:
  - Materials for embedded Linux development boards
  - Some academics use it for coursework
  - Event materials: slides and links to videos for ELC
- Other areas of the site are often out-of-date
- I feel like the site is underutilized for sharing information
- What to do next....? (Any volunteers?)

Outline

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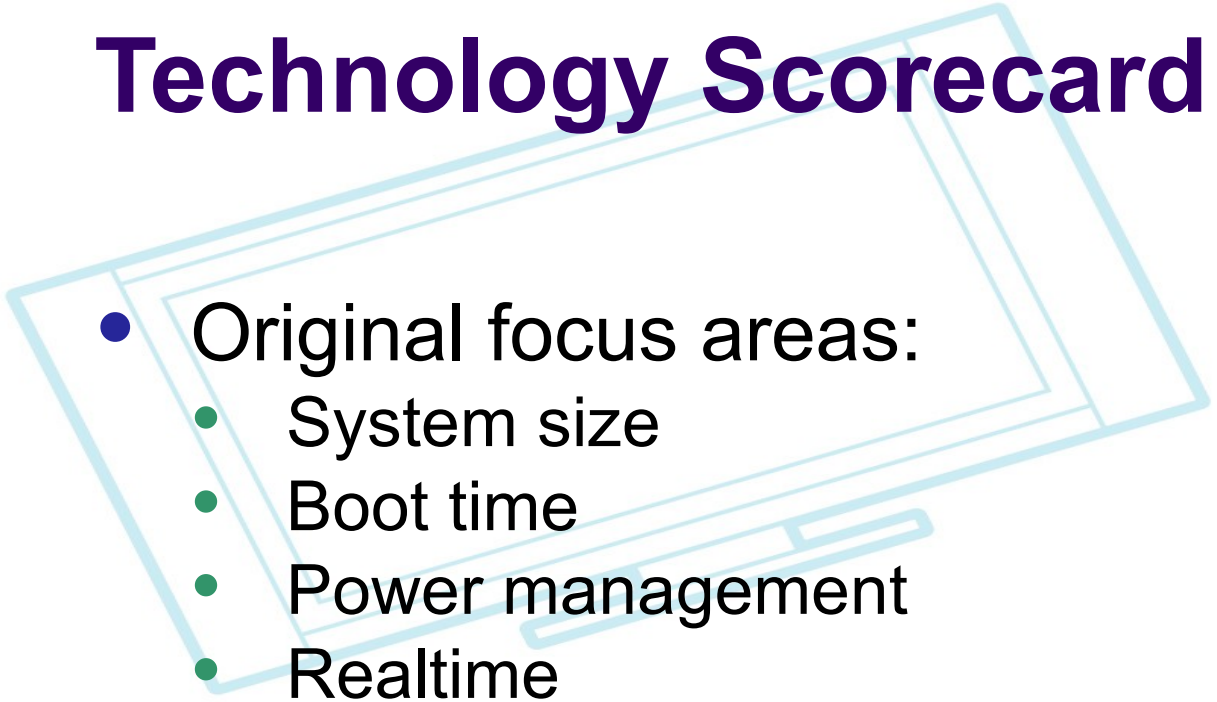
Technology Scorecard



- Original focus areas:
  - System size
  - Boot time
  - Power management
  - Realtime
  - Security

Technology Scorecard

- Based on contributions in the last few years:

- System size – done
- Boot time – done
- Power management – done
- Realtime – done
- Security – in progress

- Congratulations everyone!! We did it!!
  - World(s) domination achieved!

Technology Scorecard (reality and explanations)

- System size – done
  - Lower limit is about 16M, and it's not getting any better
  - Alas, Linux will never be on 1-cent processors
    - The 10 trillion IoT sensors will be running something else (darn)
- Boot time – done
  - Cold boot boot time reduction largely abandoned in mainline
    - People do heroic special-casing to get low boot times, when required
  - Most products use either suspend/resume or low-power idle

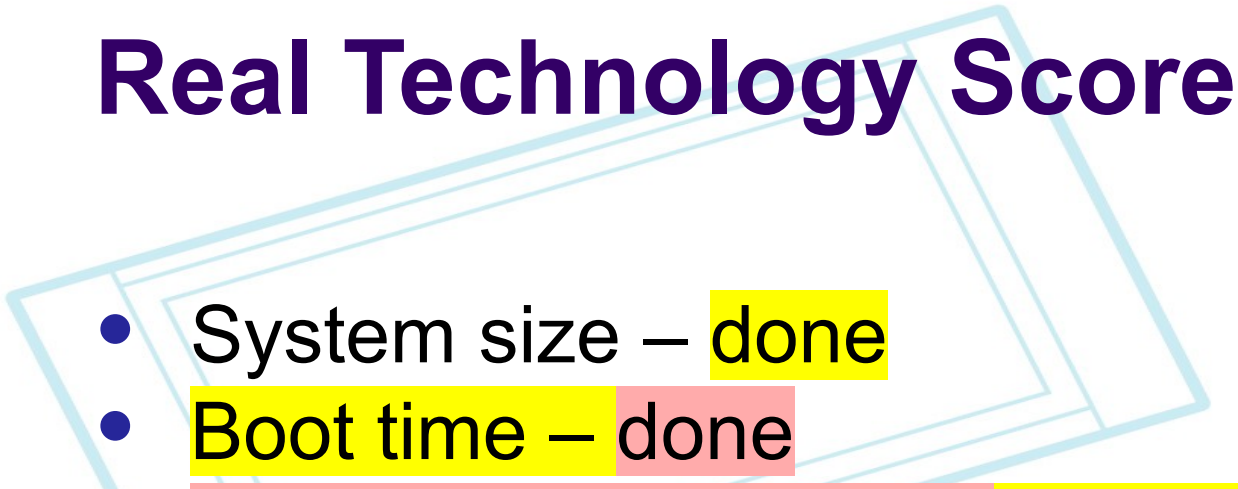
Technology Scorecard (explanations)

- Power Management – done??
  - governers, frequency scaling, power domains, power qos, and power scheduling features are all upstream
  - It requires SoC and board support (e.g. driver pm integration) for it to work
  - It's now mostly a BSP (Board Support Package) problem

Technology Scorecard (explanations)

- Realtime – done??
  - PREEMPT_RT code is (*almost all*) upstream!!
  - But it requires ongoing maintenance to avoid changes that damage realtime performance
- Security – in progress
  - kernel hardening, handling security reports, Rust drivers
  - Alpha/Omega project

Real Technology Scorecard



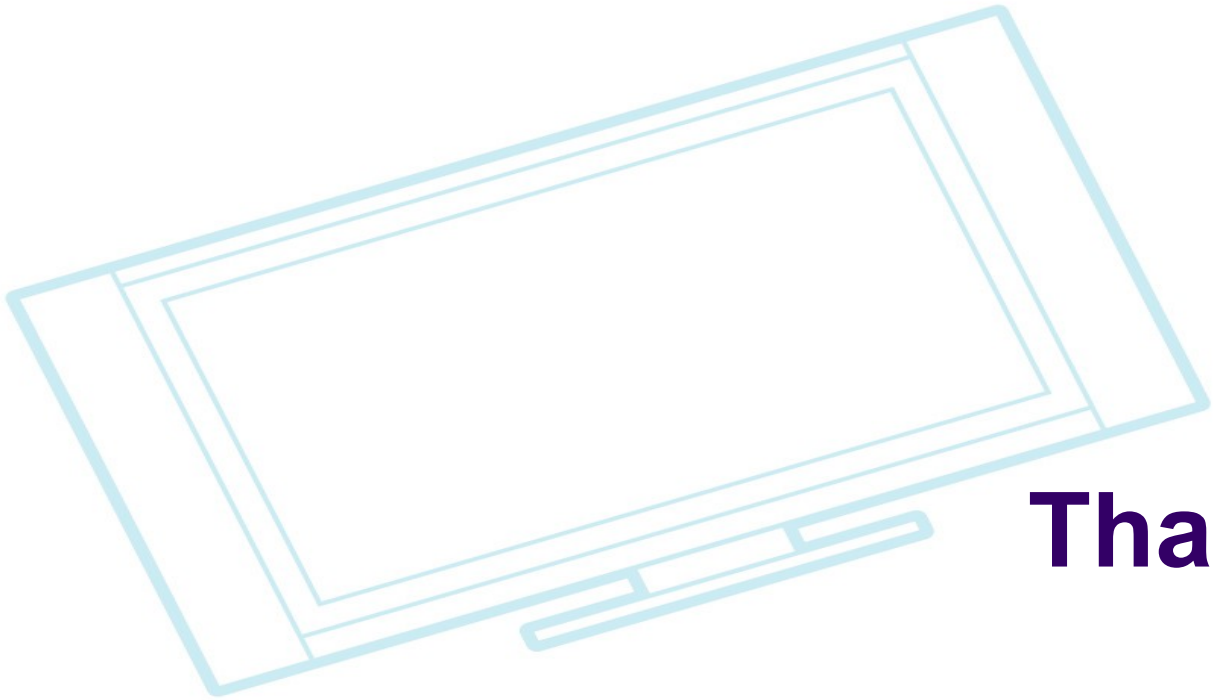
- System size – done
- Boot time – done
- Power management – done??
- Realtime – done??
- Security – in progress

Recognise now that all of these are “holistic”.

- All of these require pervasive, constant maintenance, distributed throughout the code base

Development Scorecard

- Build systems/Distros - good
- Training/Consulting - good
- Toolchains – good
- Debugging capabilities – good
- Languages – good
- Test Systems – in progress
- Hardware support – in progress



Thanks!